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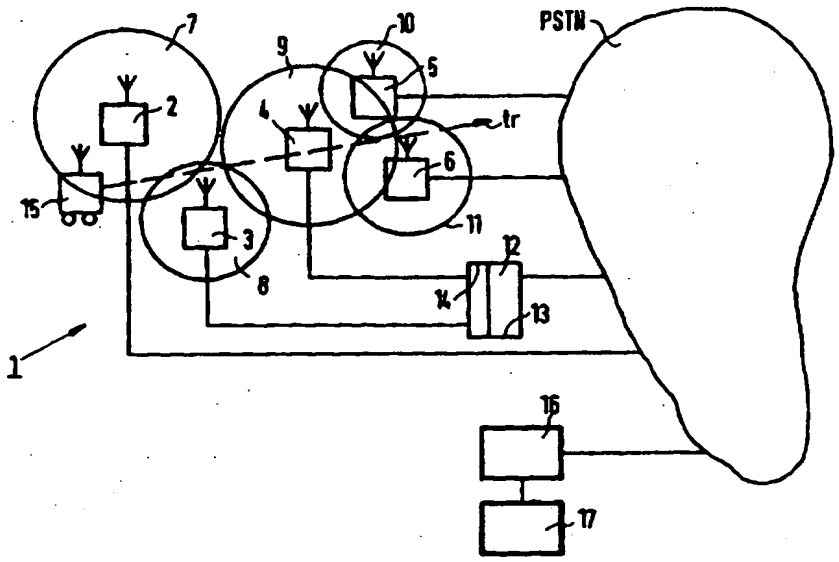

(57) Abstract

Known is a wireless object locating system (1) in which vehicles (15) can be located and followed with great position accuracy. The known system (1) is a combined GPS and cellular mobile radio system. Such a system (1) is complicated and expensive, and furthermore alarm calls are charged. An inexpensive and simple wireless object locating system (1) is proposed only using the infrastructure of a micro-cellular telephony system (1) or a cordless telephony system (1). By applying an emergency call service in such a system alarm messages (40) can be transferred to a central alarm station (16) without being charged. Preferably, a DECT system (1) is applied, the DECT Standard providing by-passing of emergency call messages (40) in private radio base stations (2, 3, 4, 5, 6) without normal call validation.

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"A wireless object locating system and a central station and a radio alarm apparatus"

The present invention relates to a wireless object locating system comprising a radio alarm apparatus for attaching to an object, which radio alarm apparatus comprises a security arrangement for sensing an alarm condition of the object, and an alarm transmitter for transmitting an alarm message to a central alarm station, whereby the security arrangement is arranged for producing an alarm signal when the alarm condition is sensed. Such a wireless object locating system is used for identifying the position of valuable movable objects, such as a vehicles or the like, when stolen, or for identifying other movable objects, when an alarm condition occurs, such as with elder or disabled people, or on assault, on burglary, on accident, or the like.

The present invention further relates to a central station and to a radio alarm apparatus for use in such a system.

Such a wireless object locating system is known from the European Patent Application No. 0 242 099. The known system is a combined cellular mobile radio and global positioning system. The known system comprises mobile radio terminals having a mobile radio transceiver for communicating with mobile radio base stations which are coupled to a switched telephony network that can be a public network. In addition thereto, the mobile radio terminal, which is comprised in a vehicle for instance, comprises a global positioning receiver, like a so-called Navstar receiver, periodically determining a position of the vehicle at which the mobile radio terminal is attached or in which the mobile radio terminal is located. The mobile radio terminal further comprises an anti-theft-security arrangement that produces an alarm signal, when armed and when an alarm condition occurs such as an attempt by an unauthorised person to steal the vehicle. The security arrangement is armed by an authorised user of the vehicle, when leaving the vehicle. For disarming the security arrangement a disarm receiver such as an infrared or very short range radio receiver is provided which can be operated by an authorised user of the vehicle only, by entering a code on a device which is coupled to the disarm transceiver, either wireless or by wire. When an alarm condition occurs, a currently determined position of the vehicle is sent to a

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central despatch office in an alarm message by the mobile radio transceiver *via* a mobile radio network and the switched telephone network to which the central despatch office is coupled. When the vehicle has been stolen, the vehicle can be continuously located. The central office evaluates the alarm message, and an appropriate action can be taken. Although the location of the vehicle can be accurately determined an followed with such a system, when the vehicle is intruded and/or stolen, the known system is complicated because of the additionally required GPS (Global Positioning System) parts. Such additional GPS parts also increase system costs. Furthermore, when the mobile radio terminal transmits alarm messages when the vehicle is stolen, the mobile radio's subscriber is still has to pay for call charges.

In the European Patent Application No. 0 380 075 a radio automatic alarm transfer system is described for detecting an abnormal condition of an automobile. In this system, which is a multi channel access mobile radio system, an exclusive upstream and downstream channel are applied to and from a base station of the mobile radio system for transferring alarm messages from the automobile to the base station, and for alerting an owner of the automobile having a mobile radio handset with an alarm sound actuator which is actuated by means of an alarm message received *via* the base station, when an alarm condition occurs in the automobile, respectively. No central alarm evaluating and object positioning station is disclosed.

In the German Patent No. 26 41 282, a traffic emergency system is disclosed for centrally evaluating emergency calls, such as calls reporting accidents with or without personal injuries at an accident's location, from relay stations covering a geographical area. The location of the accident is determined on by direction finding based on data from a number of relay station, intersecting directions giving the location of the accident. Neighbouring relay stations placed at a distance of 10 kilometres approximately, with respect to each other.

It is an object of the present invention to provide a wireless object locating system of the above kind, which is relatively cheap, both in system structure and in system operation, and which is less complicated than known systems.

To this end the wireless object locating system according to the present invention is characterised in that the alarm message is comprised in a wireless telephony emergency call message, and that the alarm transmitters are wireless telephony transmitters

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which are arranged to transmit the emergency call message to the central alarm station *via* a plurality of base stations which are comprised in the system, whereby the base stations are coupled to the central station *via* a switched telephony network, and the base stations cover a wide area, and whereby the central station is arranged to determine a location of the object from a location of a base station receiving the emergency call message. Herewith, for locating stolen objects for instance, use is made of an infrastructure of a wireless telephony system, without an additional system being necessary for determining a position of the object. The present invention is based upon the insight that it usually is not necessary to follow a vehicle with very great accuracy, when stolen, and further on the insight that, when an existing mobile or cordless radio system is available covering a large area with base station, the resolution of placement of base stations is such a system can be applied for locating purposes, when such a resolution is sufficiently small. It was also realized that in wireless telephony systems, emergency calls might by-pass a normal call validation applied for non-emergency calls.

In an embodiment of a wireless object locating system according to the present invention, the alarm message comprises an object identifier and/or a base station identifier. Herewith, the central alarm station can determine the location of the object when the security arrangement is still attached to it, and the base station via which the message was submitted, and thus, with the resolution with which the base stations are scattered over the coverage area of the system, the location of the object.

In an advantageous embodiment of a wireless object locating system according to the present invention, the base stations form a micro-cellular network which is a cordless telephony network according to the so-called ETSI (European Telecommunications Standards Institute) DECT-Standard (Digital European Cordless Telecommunications Standard). In the DECT-Standard, pr ETS 300 175-9, March, 1992, p. 25, par.4.1.48 and p. 40, par. 5.2.48 an emergency service access request is specified. The Standard specifies that the base station or cordless telephony fixed part must be able to distinguish between emergency calls and non-emergency calls to ensure by-passing of the normal call validation and establishment mechanisms if desired.

Further embodiments are claimed in the dependent claims, such as a range of 20 to 400 meters within which a majority of neighbouring base stations are located. This range determines the resolution with which the objects can be located.

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The present invention will now be described, by way of example, with reference to the accompanying drawings, wherein

Fig. 1 schematically shows a wireless object locating system according to the present invention,

Fig. 2 shows a vehicle as an object to which a radio alarm apparatus is attached,

Fig. 3 shows a radio alarm apparatus according to the present invention,

Fig. 4 shows an alarm message according to the present invention,

Fig. 5 shows a radio base station for use in a wireless object locating system according to the present invention, and

Fig. 6 shows a central alarm station for use in a wireless object locating system according to the present invention.

Throughout the figures the same reference numerals are used for the same features.

Fig. 1 schematically shows a wireless object locating system 1 according to the present invention, which comprises a network of radio base stations 2, 3, 4, 5 and 6, covering areas 7, 8, 9, 10, and 11, respectively. In a complete network, covering a country or even a number of countries, for the purpose of the present invention, much more radio base stations are needed but for ease of survey only some of them are shown. For the purpose of the present invention, at least a majority of neighbouring radio base station are located at short distance with respect to each other, a radio base station typically having a range of 20 to 400 meters. In this respect, in free space the range is greater than indoors such as in an office environment in which a plurality of radio base station might form a local network coupled to a PABX (Private Automatic Branch Exchange) 12, the radio base stations 3 and 4 for instance. The PABX comprises a network interface part 13 for coupling to a switched telephone network like a PSTN (Public Switched Telephone Network), and a cordless extension 14 to which the base stations 3 and 4 are radio fixed parts covering the areas 8 and 9. The network covered by the base stations 2, 3, 4, 5, and 6 can be a microcellular mobile radio network, or can be a cordless telephony network. Preferably, the base stations network is a DECT system (Digital European Cordless Telecommunications), as specified by ETSI (European Telecommunications Standards Institute), such a DECT system specifying an emergency call message that can be applied to convey an alarm message (to be

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shown in the sequel) from an object 15, which preferably is a vehicle. In the wireless object locating system according to the present invention, the vehicle 15 travels through the base stations network, when having been stolen, i.e. when an alarm condition occurs, or otherwise transmits an alarm message when intruded or otherwise affected by an unauthorised person. Travelling through the network is indicated with a trajectory tr. According to the present invention, alarm messages are then sent to a central alarm station 16 *via* the base stations and the switched telephone network. The central alarm station 16 comprises a database 17 in which subscriber data of subscribers that have subscribed to the wireless object locating system 1 are stored. These subscribers are authorised users or owners of vehicles comprising a radio alarm apparatus (to be shown in the sequel) according to the present invention. When an alarm message arrives at the central station 16 it evaluates this message on the basis of the data stored in the data base 17. Upon this evaluation, an appropriate action can be taken such as warning the authorised owner of the vehicle 15 or an authority such as the law. This authority can try to locate the vehicle, which either stands still or is driving through the base stations network, on the basis of data got from the locating system's operator. The resolution of locating the object 15 is determined by the placement-density of the radio base stations in the network. The system 1 can also be used for other applications, such as locating elder or disabled people, locating where an assault, burglary or accident occurred, or the like.

Fig. 2 shows a vehicle as the object 15 to which a radio alarm apparatus 20 is attached, which comprises an alarm sensor 21 coupled to a security-arrangement 22 that is coupled to an alarm transmitter 23. When the sensor 21 senses an alarm condition, an alarm message (to be shown in the sequel) is transmitted by the alarm transmitter 23 via an antenna 24 mounted on the vehicle 15. The radio alarm apparatus 20 and the antenna 15 can be concealed somewhere in the vehicle 15 such that an unauthorised person might not be aware of the radio alarm apparatus. The sensor 21 can be any suitable alarm sensor such as a motion/shock detector to sense the forcing of vehicle locks, window breakage or the forcing open of the vehicle's hood or trunk, or the like. The security arrangement 22 can be any off the shelf arrangement, such arrangements being well-known.

Fig. 3 shows the radio alarm apparatus 20 according to the present invention, which preferably comprises a DECT transmitter 30 which is coupled to the antenna 24 and to a local oscillator 31. The radio alarm apparatus 20 further comprises a so-called DECT burst-mode controller 32, an Integrated Circuit type PCD5032 for instance, which is coupled at output side to the DECT transmitter 30 and at input side to a programmed microcontroller 33 comprising ROM and RAM as usual (not shown). The

microcontroller 33 is coupled to the alarm sensor 21 *via* the security arrangement 22. The microcontroller 33 is further coupled to a disarming arrangement 34 which can be any simple and well-known electronic device for providing a trigger signal tg to the microcontroller 33 for disarming the security arrangement 22 by means of a disarming signal dm. An authorised person 35 can activate the disarming arrangement 34 by means of a code transmitted through an infra-red transmitter 36 to an infra-red receiver 37 which is coupled to the disarming arrangement 34. Instead of a wireless infrared link also a very short distance radio link can be applied, or even a wired link within the vehicle. The receiver 37 can be hiddenly mounted in the vehicle 15. The security arrangement 22 can be armed when the authorised person 35 leaves the vehicle 15, possibly delayed by means of a delay timer (not shown).

Fig. 4 shows an alarm message 40 according to the present invention, in the given example being a DECT emergency call message of which the format is well-known and is described in the DECT Standard. Such a message 40 is comprised in a DECT TDMA time slot (not shown). The message 40 comprises an emergency call indicator EC, and an object identifier OI which identifies the object. Such an identifier can be a unique code supplied by the central alarm station's operator or alarm service provider. The object identifier OI is stored in the database 17 and in an ID-ROM (not shown) which is coupled to the microcontroller 33. The object identifier OI is supplied when an authorised user of a vehicle subscribes to the wireless object locating system 1. The message 40 further comprises a central alarm station's call number CA_CN, which in a DECT system is automatically dialled by a base station receiving the alarm message 40, a normal call validation and establishment mechanisms in such a base station being by-passed. For further details as to DECT emergency calls referred is to the DECT Standard. This has the advantage that private DECT radio base stations can be used without a private DECT radio base station's owner noticing that such an emergency call is being made, or with such an owner being charged for such a call. Emergency calls, namely, are free of charge. The alarm service provider, which makes use of the public switch telephone network PSTN, has to agree upon use of such a network and upon routing of special alarm messages to its central alarm station with the telephone network operator. The alarm service provider might be asked a fee by the switched telephone network operator, an annual fee on the basis of the number of subscribers to the wireless object locating system for instance. The alarm message 40 can be distinguished from other emergency call messages by a message code MC. A base station receiving the alarm message 40 from the vehicle 15 strips the emergency call indicator EC from the message 40 and adds its base station identifier B_ID to the message. This stripped and supplemented

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message is sent to the central alarm station 16 for evaluation. The switched network operator knows the location of base stations by their telephone number and adds the base station's call number B_CN to the message before sending it to the central alarm station 16. Herewith, the central alarm station can determine the location of the base station transferring the vehicle's alarm message 40.

Fig. 5 shows the radio base station 2 for use in the wireless object locating system 1 according to the present invention. The radio base station 2, which preferably is a DECT radio base station, comprises an antenna 50 which receives the emergency call messages 40 according to the present invention. The antenna 50 is coupled to a duplexer or antenna switch 51 which periodically switches the radio base station 2 between a transmit and receive mode. The antenna switch 51 is coupled to a zero-IF (Intermediate Frequency) receiver 52 and to a transmitter 53. The receiver 52 and the transmitter 53 are coupled to a local oscillator/synthesizer 54, and to a burst-mode controller 55 which is coupled to a line interface circuit 56 *via* an ADPCM Codec 57. The line interface circuit 56 is coupled to the switched telephone network PSTN, possibly *via* a PABX such as the PABX 12. The base station 2 further comprises a programmed microcontroller 58, which is coupled to the burst mode controller 55 and to the ADPCM Codec 57, in addition to usual base station's tasks, controls the routing of a received emergency call message 40 after stripping and adding of information as described. For a more detailed description of a DECT station, referred is to the article "Digital kommunizieren mit DECT", J. Nieder, Funkschau 10/1993, pp. 74-77. The advantage of using a DECT system is that it is expected that the DECT system will cover a very large area in the future, e.g. the total of Europe or even a larger coverage area.

Fig. 6 shows the central alarm station 16 for use in the wireless object locating system 1 according to the present invention, comprising a line interface circuit 60 which is coupled to a microcontroller or PC (Personal Computer) 61 which evaluates received emergency call messages using subscriber data and other data stored in the database 17, as described. The result of such an evaluation can be displayed on a terminal 62 having a keyboard and a display.

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CLAIMS:

1. A wireless object locating system (1) comprising a radio alarm apparatus (20) for attaching to an object (15), which radio alarm apparatus (20) comprises a security arrangement 22) for sensing an alarm condition of the object (15), and an alarm transmitter (23) for transmitting an alarm message (40) to a central alarm station (16), whereby the security arrangement (22) is arranged for producing an alarm signal when the alarm condition is sensed, characterised in that the alarm message is comprised in a wireless telephony emergency call message (40), and that the alarm transmitters (23) are wireless telephony transmitters which are arranged to transmit the emergency call message (40) to the central alarm station (16) *via* a plurality of base stations (2, 3, 4, 5, 6) which are comprised in the system (1), whereby the base stations (2, 3, 4, 5, 6) are coupled to the central station (16) *via* a switched telephony network(PSTN), and the base stations (2, 3, 4, 5, 6) cover a wide area (7, 8, 9, 10, 11), and whereby the central station (16) is arranged to determine a location of the object (15) from a location of a base station receiving the emergency call message (40).

2. A wireless object locating system (1) according to claim 1, wherein the alarm message (40) comprises an object identifier (OI) and/or a base station identifier (B_ID).

3. A wireless object locating system (1) according to claims 1 or 2, wherein the base stations (2, 3, 4, 5, 6) form a micro-cellular network.

4. A wireless object locating system (1) according to claim 3, wherein at least a majority of neighbouring base stations (2, 3, 4, 5, 6) are located within a range of 20 to 400 meters with respect to each other.

5. A wireless object locating system (1) according to claims 3 or 4, wherein the micro-cellular network is a cordless telephony network.

6. A wireless object locating system (1) according to claim 5, wherein the cordless telephony network is a network in accordance with the ETSI DECT-Standard.

7. A wireless object locating system (1) according any one of the claims 1 to 6, wherein the radio alarm apparatus (20) comprises a disarming arrangement (34) which is coupled to the security arrangement (22), and which is arranged to disarm the security

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arrangement (22) on entry of a disarming-code by an authorised user (35) of the object (15).

8. A wireless object locating system according to any one of the preceding claims, wherein the security-arrangement (22) is an anti-theft-security arrangement for sensing theft of the object (15).

9. A central station (16) for use in a wireless object locating system (1) comprising a radio alarm apparatus (20) for attaching to an object (15), which radio alarm apparatus (20) comprises a security arrangement (22) for sensing an alarm condition of the object (15), and an alarm transmitter (23) for transmitting an alarm message (40) to the central alarm station (16), whereby the security arrangement (22) is arranged for producing an alarm signal when the alarm condition is sensed, characterised in that the alarm message is comprised in a wireless telephony emergency call message (40), that the alarm transmitters (23) are wireless telephony transmitters, and that the central station (16) is arranged to receive the emergency call message (40) *via* a plurality of wireless telephony base stations (2, 3, 4, 5, 6) comprised in the system (1), whereby the base stations (2, 3, 4, 5, 6) are coupled to the central station (16) *via* a switched telephony network (PSTN), and the base stations (2, 3, 4, 5, 6) cover a wide area (7, 8, 9, 10, 11), and whereby the central station (16) is arranged to determine a location of the object (15) from a location of a base station receiving the emergency call message (40).

10. A radio alarm apparatus (20) for attaching to an object (15) in a wireless object locating system (15), which radio alarm apparatus (20) comprises a security arrangement (22) for sensing an alarm condition of the object (15), and an alarm transmitter (23) for transmitting an alarm message (40) to a central alarm station (16), whereby the security arrangement (22) is arranged for producing an alarm signal when the alarm condition is sensed, characterised in that the alarm message is comprised in a wireless telephony emergency call message (40), that the system (1) comprises a plurality of wireless telephony base stations (2, 3, 4, 5, 6), and that the alarm transmitters (23) are wireless telephony transmitters which are arranged to transmit the emergency call message (40) to the central alarm station (16) *via* the base stations (2, 3, 4, 5 ,6), whereby the base stations (2, 3, 4, 5, 6) are coupled to the central station (16) *via* a switched telephony network (PSTN), and the base stations (2, 3, 4, 5, 6) cover a wide area (7, 8, 9, 10, 11), and whereby the central station (16) is arranged to determine a location of the object (15) from a location of a base station receiving the emergency call message (40).

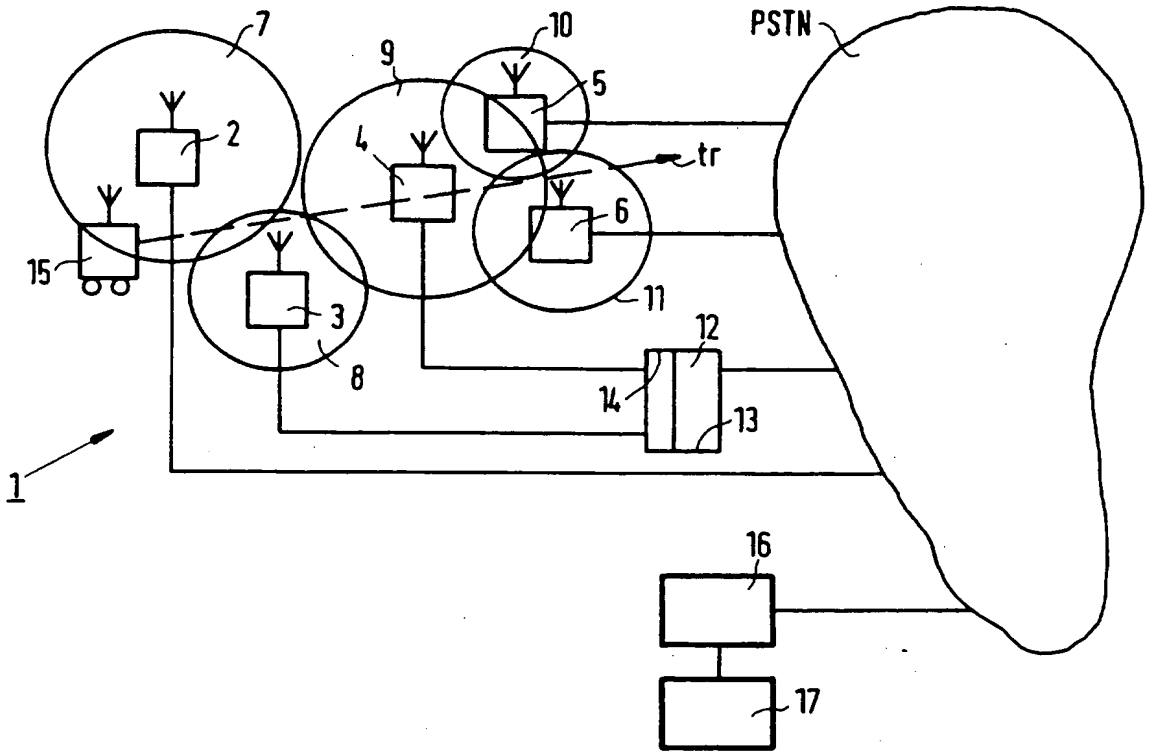

FIG.1

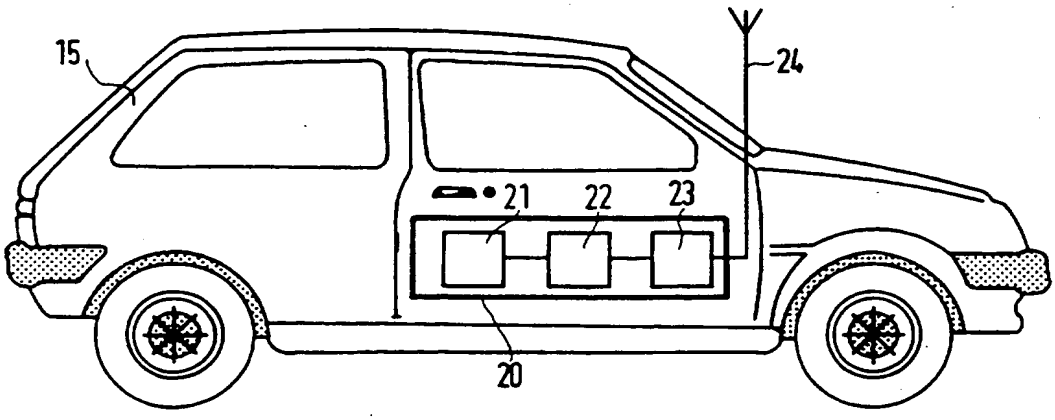

FIG.2

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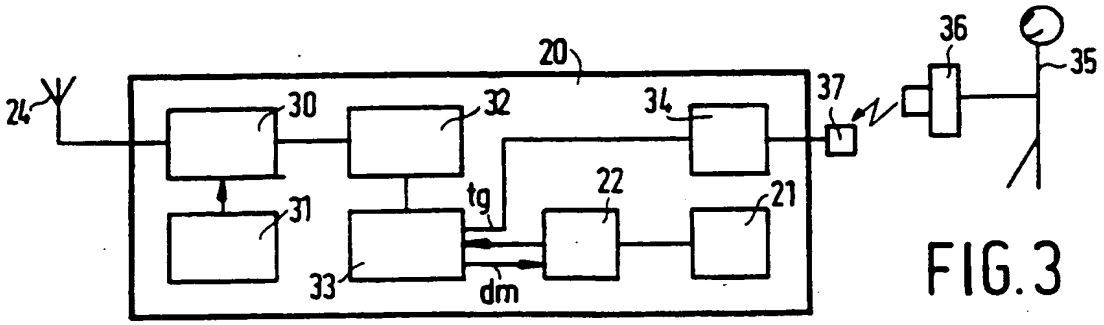

FIG.3

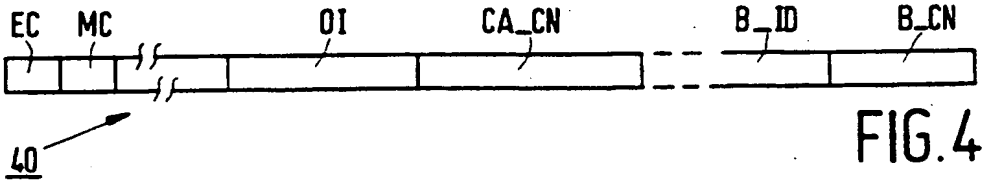

FIG.4

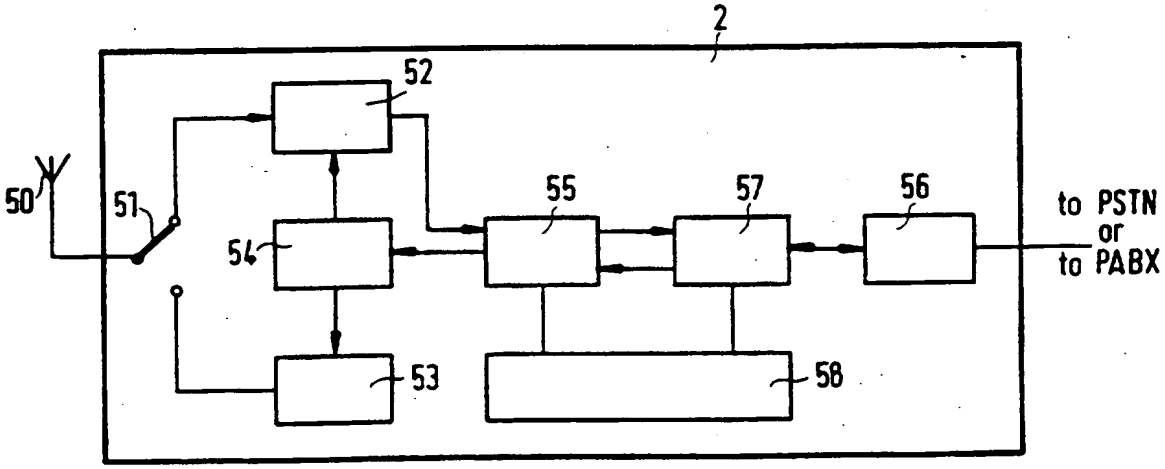

FIG.5

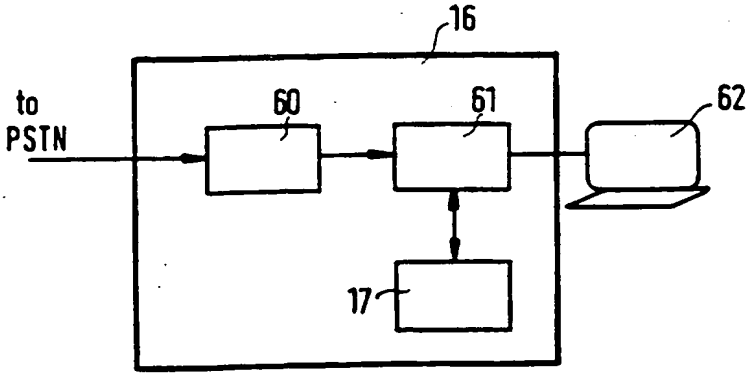

FIG.6

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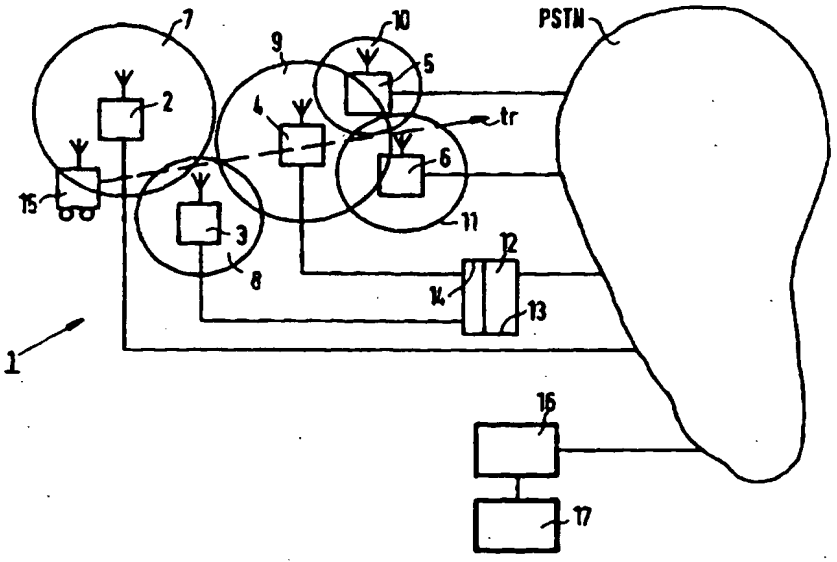

(57) Abstract

Known is a wireless object locating system (1) in which vehicles (15) can be located and followed with great position accuracy. The known system (1) is a combined GPS and cellular mobile radio system. Such a system (1) is complicated and expensive, and furthermore alarm calls are charged. An inexpensive and simple wireless object locating system (1) is proposed only using the infrastructure of a micro-cellular telephony system (1) or a cordless telephony system (1). By applying an emergency call service in such a system alarm messages (40) can be transferred to a central alarm station (16) without being charged. Preferably, a DECT system (1) is applied, the DECT Standard providing by-passing of emergency call messages (40) in private radio base stations (2, 3, 4, 5, 6) without normal call validation.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 95/00849

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G08G 1/127, H04Q 7/38, H04M 11/04, G08B 25/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G08B, G08G, H04B, H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: WPI, CLAIMS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5218367 A (E.A. SHEFFER ET AL), 8 June 1993 (08.06.93), column 1, line 53 - column 3, line 21, claims 1-16	1-10
X	GB 2247761 A (LESLIE DAVIES), 11 March 1992 (11.03.92), page 4, line 24 - page 6, line 23, claim 2	1-10
X	GB 2218835 A (TRACKMOBILE INC.), 22 November 1989 (22.11.89), page 4, line 21 - page 8, line 5, claims 1-21	1-10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
22 April 1996	23 -04- 1996
Name and mailing address of the ISA: Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Authorized officer Stefan Svahn Telephone No. + 46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 95/00849

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4611198 A (S.H. LEVINSON ET AL), 9 Sept 1986 (09.09.86), column 1, line 24 - column 2, line 30	1-4
A		5-10
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P	DE 4425530 A1 (SIEMENS AG), 23 February 1995 (23.02.95), column 1, line 3 - column 2, line 17	
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INTERNATIONAL SEARCH REPORT

Information on patent family members

01/04/96

International application No.
PCT/IB 95/00849

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 5218367	08/06/93	EP-A- 0643860	22/03/95
		JP-T- 8501645	20/02/96
		WO-A- 9324911	09/12/93
GB-A- 2247761	11/03/92	NONE	
GB-A- 2218835	22/11/89	US-A- 4891650	02/01/90
		US-A- 5055851	08/10/91
US-A- 4611198	09/09/86	NONE	
DE-A1- 4425530	23/02/95	NONE	

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